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WINE GRAPE PRODUCTION IN CONNECTICUT: A FINANCIAL ANALYSIS

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I. INTRODUCTION

Grape and wine production in Connecticut have increased significantly over the past two decades. In 2000, the State had 10 commercial wineries producing 375 tons of grapes on 145 acres (Albu Consulting, 2005). According to the last agricultural census, the number of commercial producers had risen to 78 operations cultivating 356 acres of grapes (NASS, 2017). And, in 2019, we had over 40 operating vineyard/wineries that participated in the CT Wine Passport program (this is not the total number of wineries in CT, just those participating in this program).

According to Connecticut General Statutes (Chapter 545, Section 30-1(e)(5)), licensed wineries are required to utilize at least 25% Connecticut grown grapes in their wines. In addition to this General Statute, there is a program and designation of *Connecticut Grown,* which requires wineries to use at least 51% CT grapes. To meet demand for their products, Connecticut wineries typically import grapes, grape juice, and concentrate from various locations including New York State and California (Albu Consulting, 2005). These imports suggest that expanding local grape production could make an important contribution to the growth and sustainability of the Connecticut wine industry.

The general objective of this report is to contribute to decision making by presenting a financial analysis for grape production in Connecticut using a representative farm model. The remainder of this report is organized into four sections. Section II explains the methodology used followed by the results in Section III. The report ends with a summary and conclusion in Section IV.

II. METHODOLOGY

This section presents the methodology used to develop our analysis. We first discus the characteristics of the representative vineyard used. This is followed by a brief discussion of the procedures applied to undertake the financial evaluation.

The Representative Farm

A representative farm model is developed based on information assembled from a variety of sources (Cesaro et al., 2008; French, 1977). The intention is to model a farm that is *representative* of the typical situation present in the industry and location under analysis. These types of models are useful in investigating *a priori* the impact of different assumptions, such as alternative technologies, yields, and prices (Herbst, 1996). Moreover, Köbrich et al. (2003) contend that the Representative Farm Model is a valuable tool for potential investors and producers while acknowledging that every firm has its own set of unique features and challenges.

Our representative vineyard is constructed based on information gathered from the literature, including previous grape studies for Connecticut (e.g. Jelliffe, 2012; Jelliffe and Bravo-Ureta, 2013), statistical information from USDA censuses and surveys, and interviews with Connecticut grape producers. Below we present the specific characteristics and assumptions made and how the figures were derived, followed by a summary of the base case representative farm (see Table 1).

Base Case Assumptions

Farm Size: The representative farm has a total of 10 acres.

Grape Varieties: The analysis of the representative farm includes 9 varieties of grapes, chosen for their cold hardiness and common practice in Connecticut.

Grape Prices: The Base Case prices are set at an inflation-adjusted price based Jelliffe and Bravo-Ureta (2013). The Vinifera and Hybrid set price is $2,000 per ton, i.e., $1/lb., based on information from buyers at CT wineries.

It is also assumed that prices, in real terms (adjusted for inflation), remain constant over the 20-year life of the project analyzed in this study. The evidence shows that real grape prices experienced limited annual growth over the past 20 years. (NASS, U. 2019, ’17, ’12, ’07, ’02)

Yields: The yields used for each variety are taken from the information provided by Cornell’s Viticulture and Enology Extension Department and confirmed by field information from producers. Individual varietal yields can be found in Table 2.

Land and Values: We assume that the land is owned and remains as such throughout our 20-year planning horizon. The assumed rented rate for land is fixed at $200 per acre per year over the investment period.

Equipment: The new equipment cost information was obtained from established agricultural equipment suppliers (Table 3). The equipment set was generated based on the information provided by the farmers interviewed. Particular attention was given to the representative scale of operations for farms that strictly produce wine grapes. (Machinery Pete, 2017)

Labor: The estimated labor expense incorporates an unskilled worker at $13.50/hr. and a skilled worker at 17.00/hr. These wage rates are derived from the Bureau of Labor Statistics for Connecticut Agricultural workers and some adjustments are made from our field data.

Fertilizer: The cost of fertilizer is based on the average cost per acre provided by CT growers multiplied by the acres farmed.

Fixed Cash Outflows: This flow includes insurance, equipment storage, and taxes on all equipment, liability insurance, property taxes, and rent. The itemized list can be found in Table 3.

Financial Analysis

Three indicators are used to examine the financial viability of wine grape production for our representative farm: Net Present Value; Internal Rate of Return; and Payback Period (Boardman et al., 2006; Zerbe and Dively, 1994).

Net Present Value (NPV): The NPV is the difference between the present value (PV) of cash inflows and cash outflows, i.e., the PV of net benefits. When NPV is used correctly it consistently provides the right answer for the value of the project. The equation for NPV is as follows:

$$NPV = \sum_{0}^{t} \frac{NB_t}{(1+r)^t} = -\mathrm{I}_0 + \sum_{1}^{t} \frac{NB_t}{(1+r)^t}$$

$\boldsymbol{NB_t}$ is the Net Benefits of the project in time period $\boldsymbol{t}$, $\mathbf{I_0}$ is the initial investment in time period zero, and $\boldsymbol{r}$ is the interest rate. The decision rule for NPV is as follows: NPV = 0, the investor would be indifferent; NPV > 0, invest; NPV < 0, do not invest.

Internal Rate of Return (IRR): The IRR is the interest rate at which the NPV equals zero. In other words, the IRR represents the discount rate where the PV of Benefits (B) equals the PV of Costs (C). The formula for the IRR is as follows:

$$IRR \Rightarrow \sum_{t=0}^{n} \frac{B_t}{(1+IRR)^t} = \sum_{t=0}^{n} \frac{C_t}{(1+IRR)^t}$$

The decision rule for the IRR is as follows: IRR = rR, indifferent; IRR > rR, invest; IRR < rR, do not invest. The term ***rR*** is the required rate of return which is determined exogenously.

Payback Period (PP): The PP is the amount of time periods (usually years) that it would take to recover the initial investment. The PP is calculated as:

$$PP = \sum_{t=0}^{P} NB_t \geq 0$$

The decision rules for Payback Period are as follows: PP = PPD (Payback Period Desired), indifferent; PP < PPD, invest; PP > PPD, do not invest.

It is important to note that the impact of an investment or project needs to be analyzed by comparing the situation with and without such an investment, i.e., the opportunity cost. In other words, what is being analyzed is the incremental cash flow that can be attributed to the project compared to a *status quo* case (i.e. without project). In this analysis, the without project situation assumes that owned land (10 acres) would be rented out at $200 an acre per year or $2000 total (Table 1). This value is selected based on the assumption that the rental value of land represents a good estimate of its agricultural use value. However, this value can vary significantly based on land quality and current use. Prospective growers must examine the opportunity cost of establishing a vineyard based on returns from current land use and expected net benefits, i.e., their own incremental value.

III. RESULTS

Below we first present the results of the base case scenario for the 10-acre representative grape farm based on the assumptions described above and summarized in Table 1. We then discuss the results of a sensitivity analysis on NPV, IRR, and PP.

The sensitivity analysis is performed by changing one assumption at a time and maintaining all others constant at the base case level (i.e., *ceteris paribus*). Sensitivity for the expected net returns from the project is examined under the following alternative assumptions: 1) Used equipment; 2) Farm size = 20 acres; 3) 10% decrease in yield; and 4) New York Prices. As we note below, the base case scenario generates attractive financial results; therefore, the sensitivity analysis focuses primarily on adverse assumptions.

The results of the sensitivity analysis are found in Table 5 and are reported at the farm level unless otherwise noted in the respective tables.

Base Case: The Base Case reveals an NPV of $101,366, at a 9% discount rate, for a per acre NPV of $10,137; an IRR of 15.3%; and a 12 year PP. The break-down of Base Case cashflows are contained in Table 4.

Scenario 1: Used equipment instead of new. This option decreases the startup cash outflows, which might be appealing for operators with limited financial resources or current farmers seeking alternative uses for their land and who already have the required equipment. The results here indicate: NPV = $16,221 per acre; IRR = 20.3%; and a nine year PP.

Scenario 2: Doubling Base Case farm size. The results indicate positive financial returns when acres are doubled resulting in: NPV = $19,527 per acre; IRR = 23.6%; and an eight year PP. Although this is presented at the total farm level, additions in acreage takes advantage of the economy of scale given that land purchase is not a factor.

Scenario 3: 10% Yield Reduction. Yield volatility is a common source of risk in farming and thus an important variable to include in the sensitivity analysis. The results here indicate that with a 10% yield reduction, the NPV (9% discount rate) drops to $4,628 on a per acre basis, or by $5,509 compared to the Base Case of $10,137. The IRR drops to 12.0% and the PP is 16 years. In the event that yields are lower across the life of the project, it still remains a viable investment.

Scenario 4: New York State (NYS) prices are used instead of Connecticut prices. The use of NYS prices for each variety of grapes that included in the analysis, leads a loss of $15,169 per acre (NPV); at a rate of -5.6% (IRR); and does not pay back over the 20 year investment horizon (PP) (NASS, 2018).

IV. SUMMARY AND CONCLUSIONS

The objective of this study was to examine the financial returns of a grape producing operation using a representative farm model. It serves as an update to prior studies of CT wine grape production (Bravo-Ureta, 1983; Jelliffe and Bravo-Ureta, 2013). For this study, we use various sources of information to update the current production costs and returns to generate a base case situation as well as several scenarios to examine the sensitivity of the financial results.

The analysis supports the conclusion that grape production, under conditions prevailing in Connecticut can be a viable financial undertaking. Future work on value added processing of wine and the establishment of vertically integrated farm vineyard wineries would provide a more complete picture of the industry and representative CT operations.

Studies have considered the positive economic impacts of the CT wine industry on the state economy, which has grown significantly over recent years (Heffley et al., 2010; Lopez et al., 2010, 2017). An examination of the economic impact of wineries on the CT economy found the industry generated between $145.0 to $154.2 million in sales benefits with direct industry sales making up $85.8 million, and between 635 to 978 CT jobs in 2015 (Lopez et al., 2017). Furthermore, industry growth has been highlighted with a 130% increase in sales benefits and 165% increase in CT jobs between 2007 and 2015 (Lopez et al., 2017). Under these current rates of industry expansion additional research on wine grape production is warranted as demand for CT grapes continues to increase. This study should be a useful resource to current and prospective growers seeking a basis of comparison for their operations.

Table 1. Itemized Base Case Assumptions for the Representative Farm

Item	Assumption	Comments
Prices	$2,000/ton Vinifera $2,000/ton Hybrid	Price are constant over project lifespan (20 years)
Yields	No production – Year 1-2 65% of Potential – Year 3 100% of Potential –Year 4+	Drop fruit to increase plant vigor Maturation period Yields remain constant
Land	10 acres	
Rent	$200 per acre	
Equipment, Machinery, and Buildings	Purchased new	Value of 2019 equipment
Labor	Unskilled $13.5/hr. Skilled $17.0/hr.	
Variable Expenses	Fuel, labor, fertilizer, maintenance, miscellaneous	Expenses are generally a function of acreage, time, or reported amounts
Fixed Expenses	Insurance, taxes, rent	

Table 2. Cash Inflow & Outflow Per Acre (100% Potential Yields – Yr. 4+)

Grape Variety	Yield/ Acre	Price/ Ton	Total Inflow/Acre	Total Outflow/Acre	Net Cash Flow/ Acre	Acres Planted
Cabernet Franc	2.65	2,000	5,300	3,351	1,949	1.12
Lemberger	3.42	2,000	6,840	3,351	3,489	1.11
Marechal Foch	5.00	2,000	10,000	3,351	6,649	1.11
Chardonnay	3.36	2,000	6,720	3,351	3,369	1.11
Pinot Gris	2.65	2,000	5,300	3,351	1,949	1.11
Traminette	2.94	2,000	5,880	3,351	2,529	1.11
Seyval	5.68	2,000	11,360	3,351	8,009	1.11
Cayuga White	4.95	2,000	9,900	3,351	6,549	1.11
Vidal Blanc	4.28	2,000	8,560	3,351	5,209	1.11
Total/Acre				**$ 3,350.8**	**$ 7,759.8**	**10**

Table 3. Annual Outflows Farm Totals (10 Acres)

	Year 1	Year 2	Year 3	Year 4+
Operating Expenses				
Site Preparation	1,674			
Vines and planting	6,890			
Replanting and Rogueing		389	1,280	1,460
Dormant pruning & brush removal		540	1,700	4,390
Herbicide application	322	328	328	331
Fertilization	252	263	408	941
Canopy management		1,350	3,820	5,478
Disease and insect control	874	1,182	3,305	6,495
Take away and hilling up	471	1,741	1,520	1,450
Mowing		740	842	865
Total	10,484	6,533	13,203	21,410
Establishment Expenses				
Machinery	98,000	9,800	9,800	9,800
Trellis		39,510	988	988
Drainage	43,595			
Total	141,595	49,310	10,788	10,788
Annual Fixed Expenses				
Taxes - Property	880	880	880	880
Insurance - Farm	430	430	430	430
Total	1,310	1,310	1,310	1,310
Cumulative Annual Farm Total	**$153,389**	**$57,153**	**$25,301**	**$33,508**

Table 4. Net Cash Flows and Payback Period: Base Case Farm Totals

Year	With Project Cash Inflow	With Project Cash Outflow	Without Project Cash Inflow	Without Project Cash Outflow	Incremental Cash Flow	Payback Period
1	0	153,389	2,000	1,310	(154,079)	(154,079)
2	0	57,153	2,000	1,310	(57,843)	(202,765)
3	50,438	25,301	2,000	1,310	24,448	(183,887)
4	77,598	33,508	2,000	1,310	43,400	(153,141)
5	77,598	33,508	2,000	1,310	43,400	(124,934)
6	77,598	33,508	2,000	1,310	43,400	(99,056)
7	77,598	33,508	2,000	1,310	43,400	(75,315)
8	77,598	33,508	2,000	1,310	43,400	(53,534)
9	77,598	33,508	2,000	1,310	43,400	(33,552)
*10	82,098	33,508	2,000	1,310	47,900	(13,318)
**11	77,598	78,508	2,000	1,310	(1,600)	(13,938)
***12	77,598	33,508	2,000	1,310	43,400	1,492
13	77,598	33,508	2,000	1,310	43,400	-
14	77,598	33,508	2,000	1,310	43,400	-
15	77,598	33,508	2,000	1,310	43,400	-
16	77,598	33,508	2,000	1,310	43,400	-
17	77,598	33,508	2,000	1,310	43,400	-
18	77,598	33,508	2,000	1,310	43,400	-
19	77,598	33,508	2,000	1,310	43,400	-
20	87,398	33,508	2,000	1,310	53,200	-
Net Present Value @ 9%					**$101,366**	
Internal Rate of Return					**15.3%**	
Payback Period					**12 years**	

*Equipment is salvaged at year end **Equipment is purchased to replace old *** Payback period

Table 5. Sensitivity Analysis: All Cases on a Per Acre Basis

Case	Situation	NPV/Acre @ 9%	IRR %	PP Years
Base Case	10-acres	$10,137	15.3	12
Scenario 1: Equipment Type	Used Equipment	$16,221	20.3	9
Scenario 2: Farm Size	20-Acres	$19,527	23.6	8
Scenario 3: Lower Yields	10% Reduction	$4,628	12.0	16
Scenario 4: Lower Prices	New York State	($15,169)	-5.6	20+

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